

UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 6,723,299 B1
DATED : April 20, 2004
INVENTOR(S) : Chen et al.

Page 1 of 8

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Delete title page and substitute with the attached title page.

Drawings.

Replace informal Figures 1-6 with the attached formal versions of Figures 1-6.

Column 1.

Line 61, delete "Cd".

Line 65, delete "an[]".

Column 2.

Lines 35 (both occurrences) and 42, change "Journey" to -- Journet --.

Column 3.

Line 19, delete "if".

Column 5.

Line 62, delete "id".

Column 6.

Line 8, change "Ycyclodextrin" to -- Y-cyclodextrin --.

Lines 30 and 35, delete "If".

Line 43, change "of:" to -- of --.

Column 9.

Line 32, change "cyclodextrilnml" to -- cyclodextrin/ml --.

Line 32, change "high-resolufion" to -- high-resolution --.

Line 58, change "cyclodexus" to -- cyclodextrins --.

Column 10.

Line 61, change "engage" to -- encage --.

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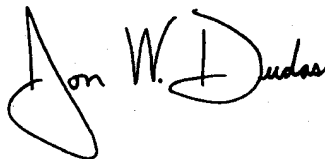
Column 11,

Lines 44 and 45, change "engage" to -- encage --.

Lines 48 and 50, change "engages" to -- encages --.

Signed and Sealed this

Thirtieth Day of May, 2006

A handwritten signature in black ink, reading "Jon W. Dudas". The signature is stylized, with a large loop for the "J" and a cursive "Dudas".

JON W. DUDAS

Director of the United States Patent and Trademark Office

(12) **United States Patent**
Chen et al.

(10) Patent No.: **US 6,723,299 B1**
(45) Date of Patent: **Apr. 20, 2004**

(54) **SYSTEM AND METHOD FOR
MANIPULATING NANOTUBES**

(75) Inventors: **Jian Chen, Richardson, TX (US);
Mark J. Dyer, San Jose, CA (US)**

(73) Assignee: **Zyvox Corporation, Richardson, TX
(US)**

(*) Notice: **Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 72 days.**

(21) Appl. No.: **10/044,317**

(22) Filed: **Jan. 11, 2002**

Related U.S. Application Data

(60) Provisional application No. 60/291,101, filed on May 17,
2001.

(51) Int. Cl.⁷ **D01F 9/12**

(52) U.S. Cl. **423/447.1; 423/447.2;
423/460; 241/16**

(58) Field of Search **423/447.2, 460,
423/455 R, 447.1; 241/16**

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,482,601 A 1/1996 Ohshima et al.
5,753,088 A 5/1998 Oik

OTHER PUBLICATIONS

U.S. patent application Ser. No. 60/291,101, Chen.
Ajayan, P.M., "Nanotubes from Carbon," Chem. Rev. 1999,
99, 1787-1799.

Yakobson, Boris I. et al., "Fullerene Nanotubes: C_{1,000,000}
and Beyond," American Scientist, 1997, vol. 85, 324-338.
Rinzler, A.G., et al., "Large-scale purification of single-wall
carbon nanotubes: process, product, and characterization,"
Appl. Phys. A 67, 29-37 (1998).

Journet C., et al., "Large-scale production of single-walled
carbon nanotubes by the electric-arc technique," Nature,
vol. 388/Aug. 1997, 756-758.

Journet, C., et al., "Production of carbon nanotubes," Appl.
Phys. A 67, 1-9 (1998).

Nikolaev, Pavel et al., "Gas-phase catalytic growth of
single-walled carbon nanotubes from carbon monoxide,"
Chemical Physics Letters 313 (1999) 91-97.

Liu, Jie et al., "Fullerene Pipes," Science, vol. 280, 1998,
1253-1256.

Stepanek, I. et al., "Nano-mechanical cutting and opening of
single wall carbon nanotubes," Chemical Physics Letter 331
(2000) 125-131.

Szejtli, Jozsef, "Introduction and General Overview of
Cyclodextrin Chemistry," Chem. Rev. 1998, 98, 1743-1753.
Chen, Jian et al., "Dissolution of Full-Length Single-
Walled Carbon Nanotubes," J. Phys. Chem B 2001, 105,
2525-2528.

Niyogi, S. et al., "Chromatographic Purification of Soluble
single-Walled Carbon Nanotubes (s-SWNTs)," J. Am.
Chem. Soc., 2001, 123, 733-734.

Dresselhaus, M.S. et al., "Science of Fullerenes and Carbon
Nanotubes," 1996, San Diego: Academic Press, 901-908.

Primary Examiner—Stuart L. Hendrickson

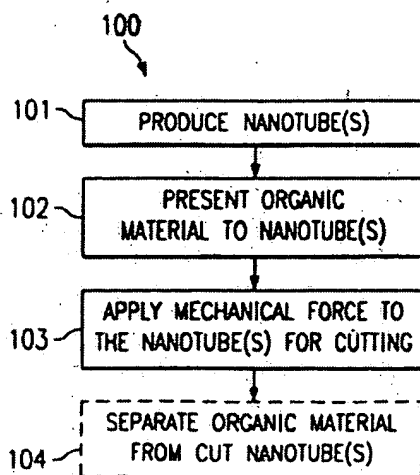
Assistant Examiner—Peter J Lish

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(57) **ABSTRACT**

A system and method are disclosed which allow for manipu-
lation of nanotubes. More specifically, embodiments of the
present invention enable various types of manipulation of
nanotubes utilizing an organic material that is presented to
the nanotubes. For example, a preferred embodiment of the
present invention enables cutting of nanotubes into short-
ened nanotubes. Other types of nanotube manipulation that
are enabled by embodiments of the present invention,
include dispersing nanotubes, enabling dissolution of
nanotubes, and noncovalently functionalizing nanotubes. The
organic material utilized in manipulating nanotubes prefer-
ably comprises a soft organic material, soluble organic
material, and/or an organic material that acts as a dispersing
reagent for dispersing nanotubes. In a preferred
embodiment, the organic material utilized for manipulating
nanotubes comprises cyclodextrin.

78 Claims, 10 Drawing Sheets



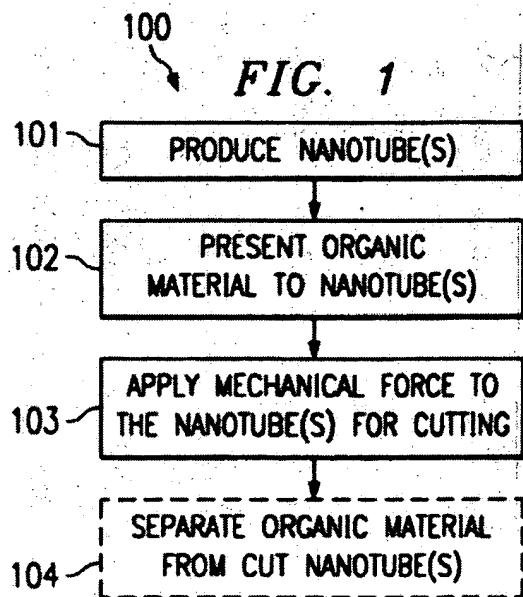
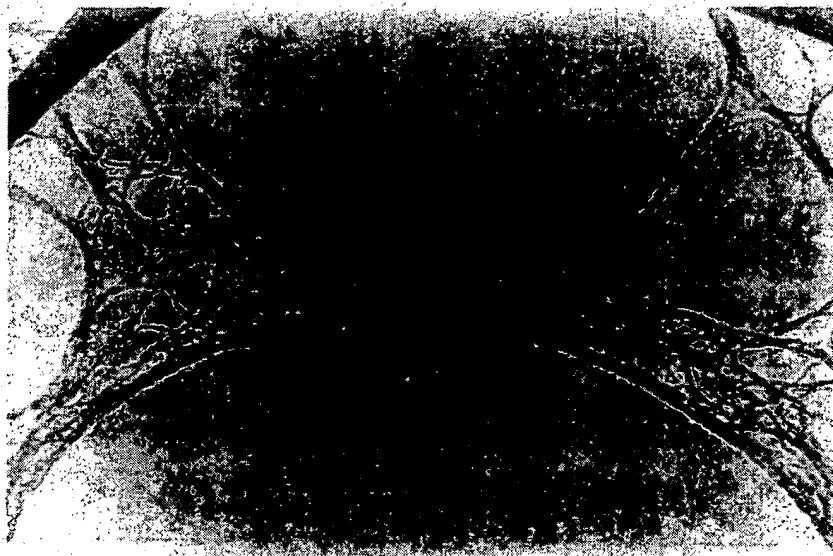


FIG. 2A



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FIG. 2B

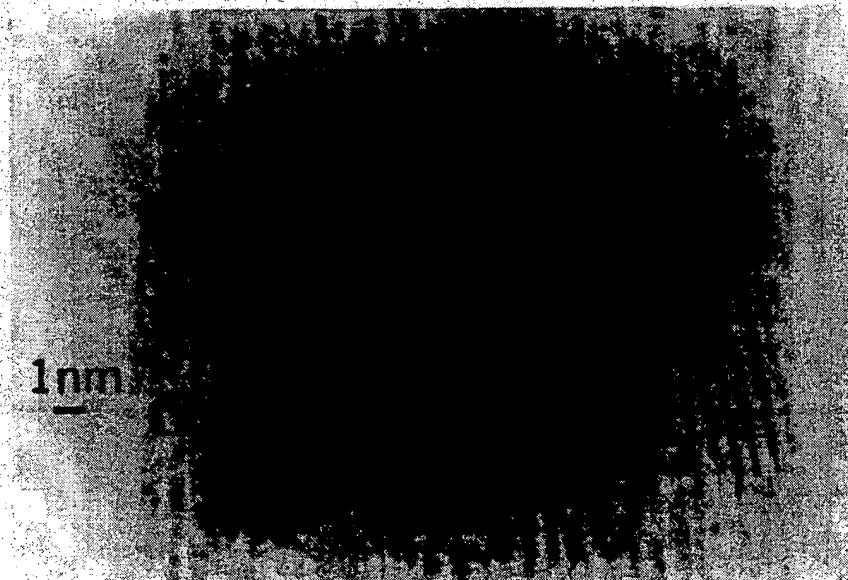
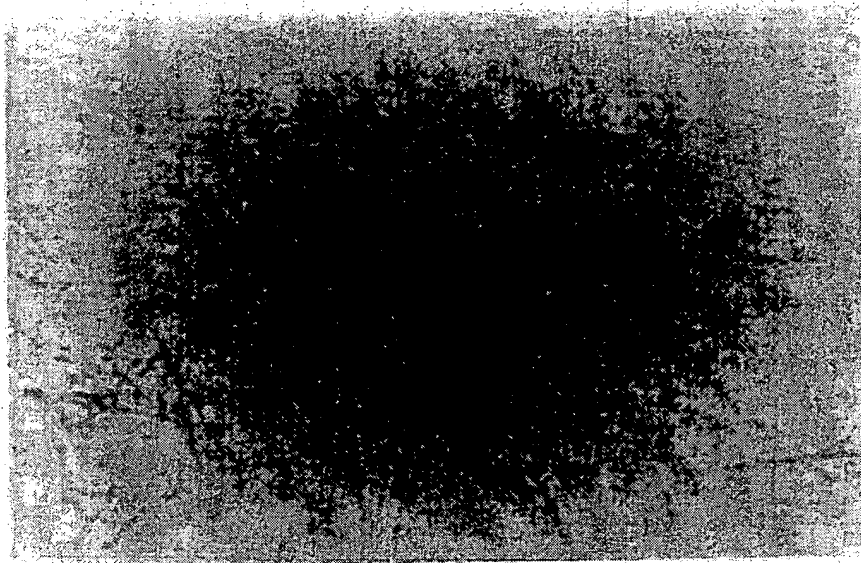


FIG. 3A



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FIG. 3B

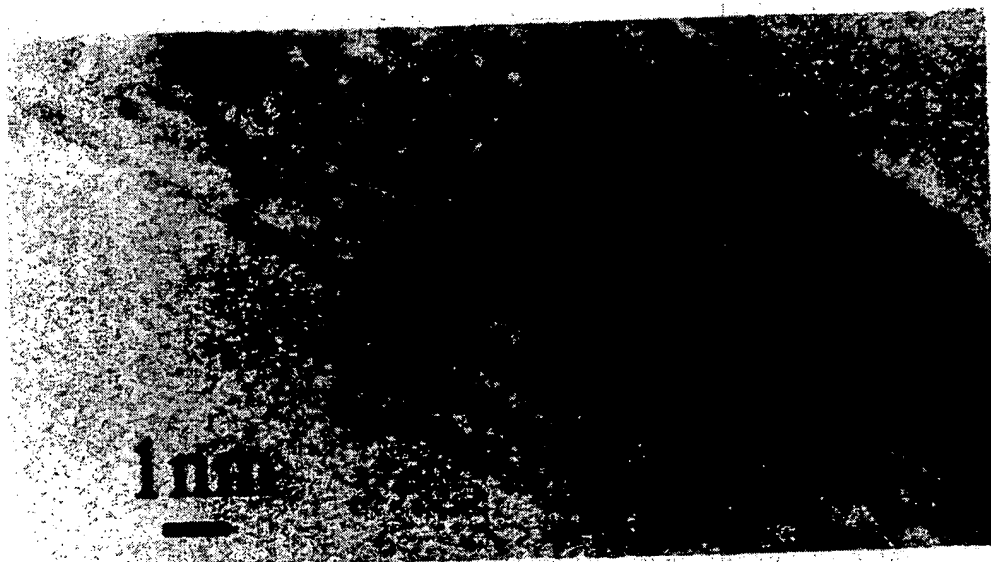


FIG. 3C



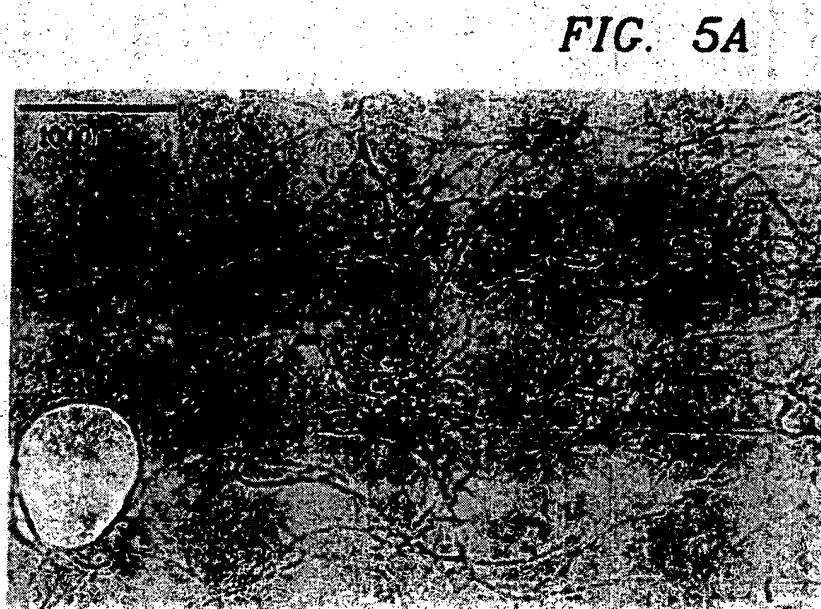
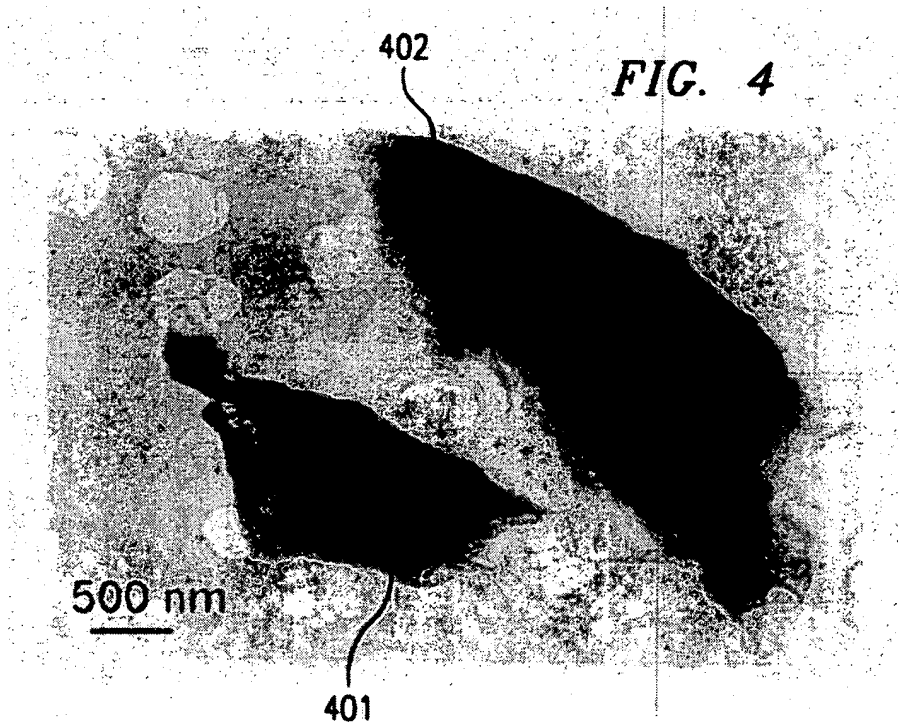


FIG. 5B



FIG. 6

